IMPACT OF METRO ON THE DEVELOPMENT OF TWIN CITY KOLKATA & HOWRAH

Masters Thesis in Urban Planning

by

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INTRODUCTION

NEED OF THE STUDY

- Twin Cities are **interdependent** for various functional purposes, such as **employment, education and businesses**.
- Importance of **intra-urban transportation** in urban development.
- **Kolkata**, the capital, is the administrative and commercial hub, **Howrah**, planned as the industrial centre.
- The **East West proposed metro corridor** will link the twin cities and will be operational in the year 2018.
- **No prior study/research** to analyze the impact of the Metro on Twin Cities.
- **No policy** to increase the metro impacts, or guide the development of Twin city Kolkata and Howrah.
- Thus this provides an opportunity to analyze the impacts along the metro and its influence on both urban areas for the future developments.

LANDUSE MAP OF KOLKATA & HOWRAH (2009)

Source: Land Use Map, KMDA, 2009

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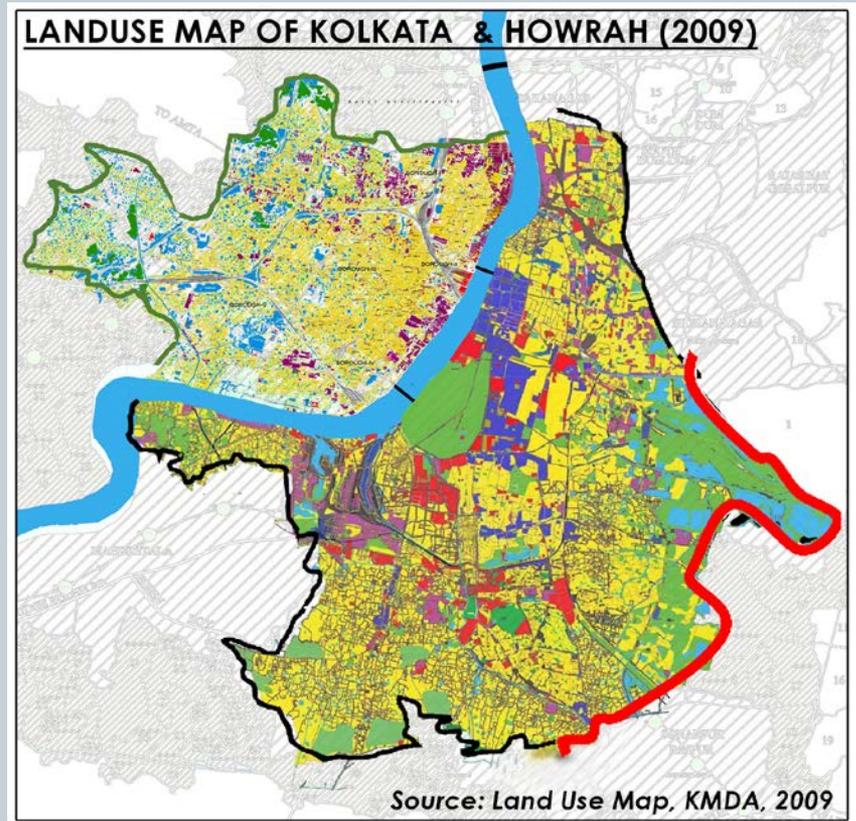
AIM & OBJECTIVES

AIM

To analyze the impact of metro as a catalyst for guided urban development of Twin cities Kolkata & Howrah and propose strategies for planned development.

OBJECTIVES

1 To review impact of metro on development patterns of cities.

2 To assess the existing urban spatial structure, landuse, land value, mass transport system characteristics, for case cities and view policy initiatives

3 To assess/analyze the existing landuse-transport system and travel patterns of users of the operational Metro corridor.

4 To evolve alternative strategies for estimating likely impacts of proposed metro rail corridor between twin cities (urban structure, mobility, environment) under alternate scenarios.

5 To prepare practical recommendations and guidelines for local authorities for mass transit supported guided urban development.

METHODOLOGY
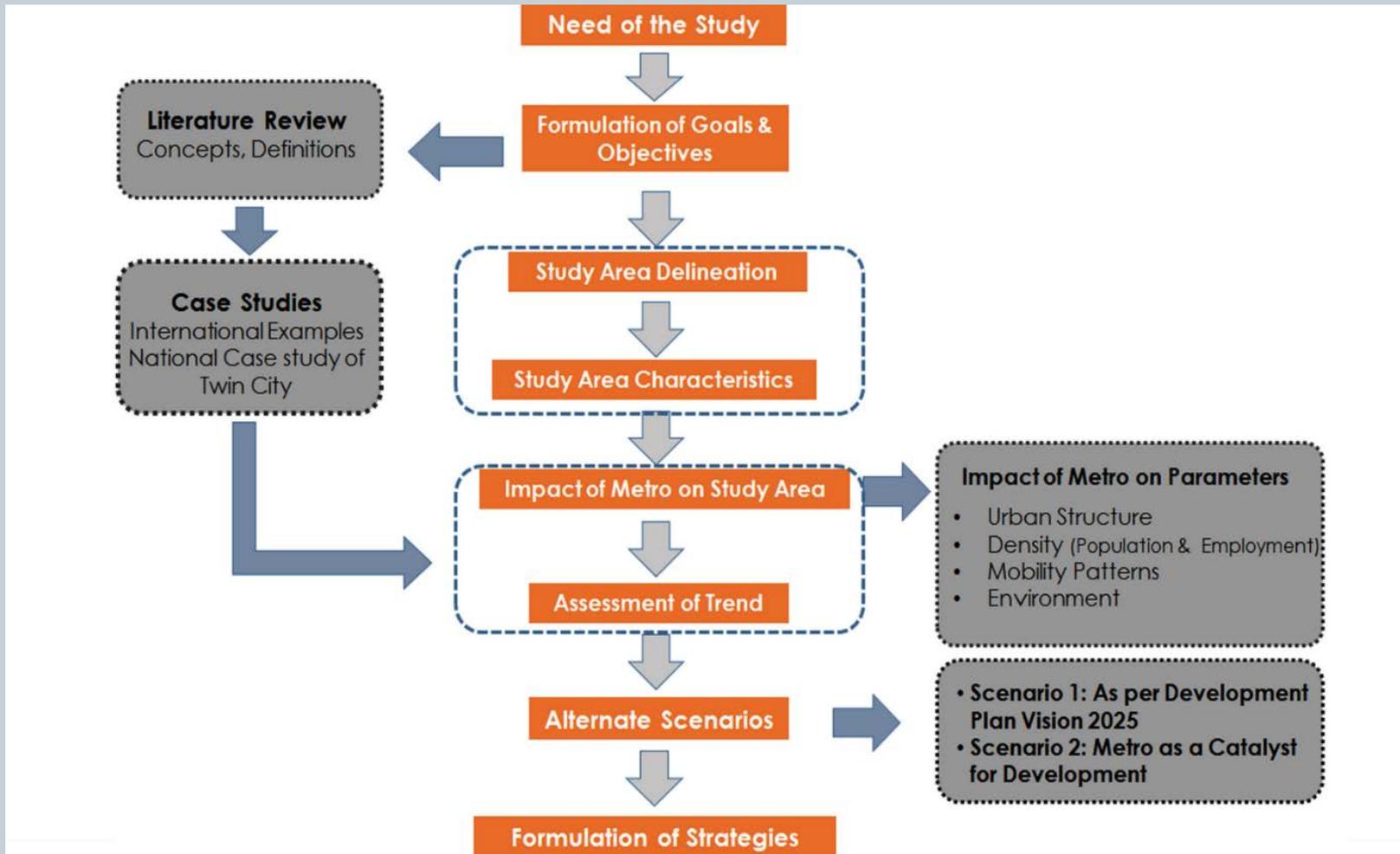
LITERATURE REVIEW

DEFINITION: TWIN CITIES

Twin cities are a special case of two cities or urban centres that are founded in close geographic proximity and then grow into each other over time, losing their mutual buffer zone.
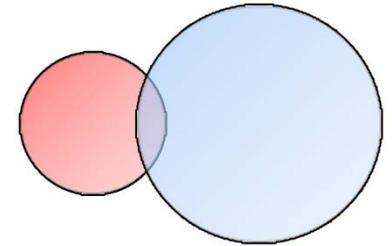

LANDUSE TRANSPORT INTEGRATION

Land use and transport are intricately related. While urban structure determines travel demand and transport supply influences urban structure. The location and design of spatial development has a fundamental influence on travel patterns. At the same time, the location and characteristics of major transport infrastructure impacts the allocation of land uses.

The integration of land use with transportation systems has to happen at all scale/ levels of planning and through multiple intervention mechanisms. The most important elements of are listed as :

1. Enabling Urban Structure
2. Public Transit and its Strategic Alignment
3. Transit oriented development & value capture
   (a. Along routes b. Around Transit interchanges)
4. Accessibility improvements in terms of local
   area plans (last mile connectivity)
5. Re-development & Re-vitalization & Transit
   (a. Inner city b. Derelict areas c. Slums)
6. Integrated Multimodal Transit Interchanges
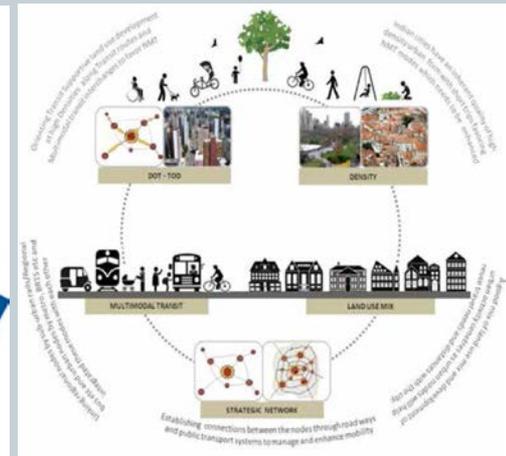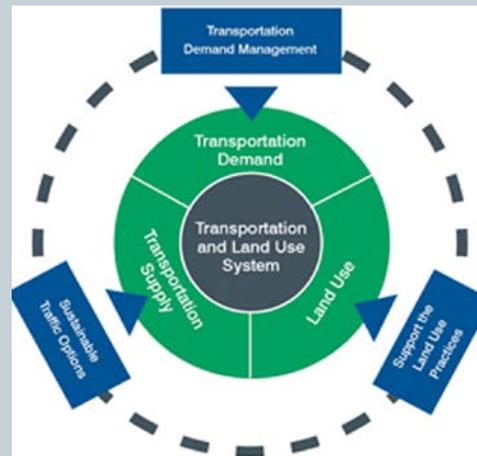
Source: Land Use Transport Integration and Density of Urban Growth, MoUD & UNDP Publication

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LITERATURE REVIEW

CASE STUDIES

CITY	Singapore			London			Copenhagen		
Metro Rail Introduced in Year	1987			1890			2002 and 2007		
Spatial Transformation	Focus on **integrated transport & land use planning**	Promoting high density compact **public transport centric urban fabric**		**Strong land-use-transport integration.**	**Delivered compact city development**	Combines **land use** (density, function) and **transport** (stations, stops).	**Urban (Finger) development follow public transport (Railways and metro)**	Suburbs will develop like pearls on a string	Green wedges of undeveloped land between fingers
Urban Structure Changes	Dense sub centres with **commercial dev. along major transport corridors** and a strong city centre			Extension of the metro Railways to the **Sub-Centres for economic growth**			Promoting **concentrated location of large office buildings** and commercial facilities **within 600m radius** from train stations **along the transit corridor**		
Network & Mobility Pattern	The network has **5 lines**	**Average daily ridership of 2.89 million (2014)**	**170.7 km** route	The network has **11 lines**	**Average daily ridership of 3.21 million (2014)**	**400 km of route**.	The **S-train network** is a metrolike serving the urban Copenhagen area. It connects the city centre and inner boroughs with the outer boroughs of Copenhagen.	**Copenhagen Metro** system serves Copenhagen, Frederiksberg and Tårnby in Denmark. Route length: **20.5 km** and has **2 lines**.	

Source: Singapore official multi-modal public transport operator website, www.smrt.org.sg

Source: London Landuse Mass Transit Integration Plan, 2001, study by London School of Economics

Source: Copenhangen Landuse Transport Integration Plan, 2001
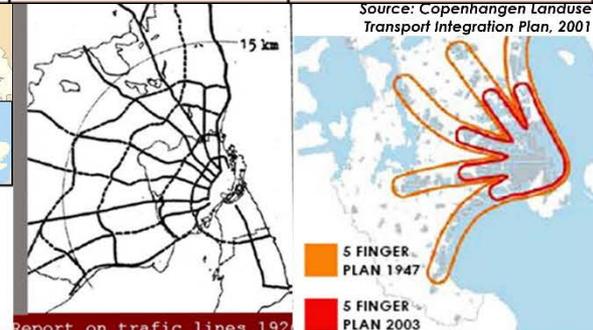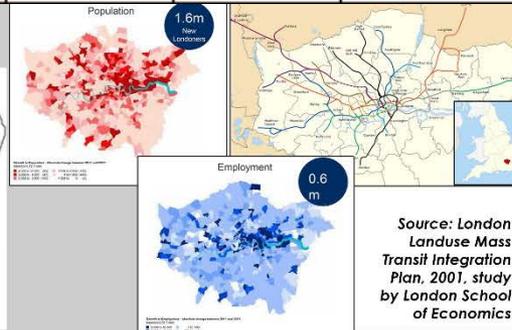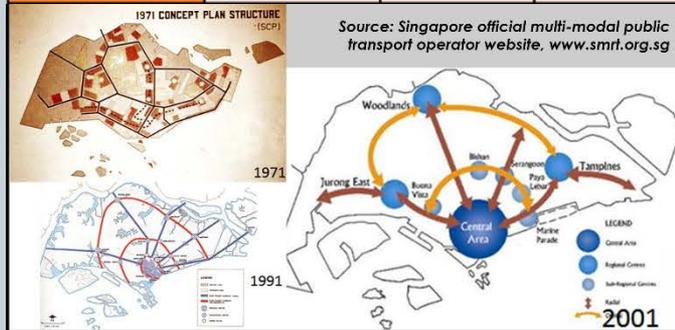
CASE CITIES PROFILE

- **Kolkata Metropolitan Area** (KMA), is the urban agglomeration of the Kolkata.
- It is the third most populous metropolitan area in India after Delhi and Mumbai.
- The Kolkata Metropolitan Area developed in a **linear North-South pattern** along both banks of Hooghly River.
- Transportation corridors such as arterial roads and metro were developed along the north-south directions.
- The **railway track and the river** running north -south are a **physical hindrance** to the development of **road infrastructure in the east west direction**.
- The **wetlands in the East** have restricted the development potential in Eastern direction. The resulting urbanization pattern is a predominantly linear form extending along the Hooghly River from KMC to Kalyani on the East Bank and from Howrah to Tribeni on the West Bank of the river.
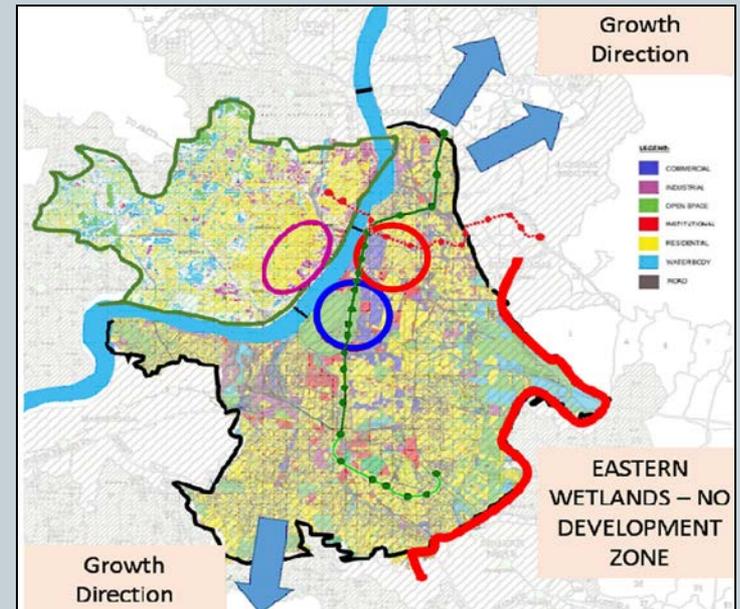

- The **administrative & commercial functions** are concentrated in Kolkata, Howrah predominantly houses the **industrial** functions.

CASE CITIES PROFILE

DEMOGRAPHIC PROFILE

City Profile	KOLKATA	HOWRAH
Physical Characteristics		
Area	187.5	64.55
Number of Wards:	144	66
Population 2011 (in lakhs)	45.8	13.62
Total No. of Workers	1795740	397048
Workforce Participation Rate	37.10%	33.95%
Density of Population (ppHA)	231.49	194.73

Source: CENSUS 2011 WEBSITE

Area	Population in lakh				
	1991	2001	2011	CAGR (1991-2011)	2021
Kolkata UA	110.21	132.05	141.12	0.0124	159.7
KMC	44.00	45.73	44.96	0.0011	45.4
HMC	9.50	10.07	13.62	0.0182	14.6

	Population
Kolkata UA	141.12 Lacs
Howrah City	13.63 Lacs
Delhi UA	163.49 Lacs
Gurgaon	8.76 Lacs

TRANSPORT SYTEM & TRAVEL DEMAND

PUBLIC TRANSPORT CHOICES

SUBURBAN RAIL
Alignments: 10 lines (KMA)
Total length: 1230 km
Total Stations: 105

CIRCULAR RAIL
Route length:24.5km (KMC)
Total Stations: 13
Total no. of Train Daily: 32

BUS SERVICES
Avg Daily Ridership in KMA:
32 lakh passengers
Total Fleet in KMC, HMC: 300

FERRY SERVICES
Total Ghats:32 (10 in
KMC,HMC)
Total no. of ferries: 42 nos.
Trips per day: 16 nos

TRAMS
Avg Daily Ridership in
KMC:
1.9 lakh passengers

METRO
Operates between Dum-Dum &
New Garia
Route length: 29km (KMC)
Total Stations: 27
Avg. Daily Ridership:5.02
Lacs(2014-15)

New Metro link projects (2010)
- EAST WEST METRO
- Joka to B.B.D. Bag
- Noapara to Barasat

Source: Comprehensive Mobility Plan for Kolkata (2008)
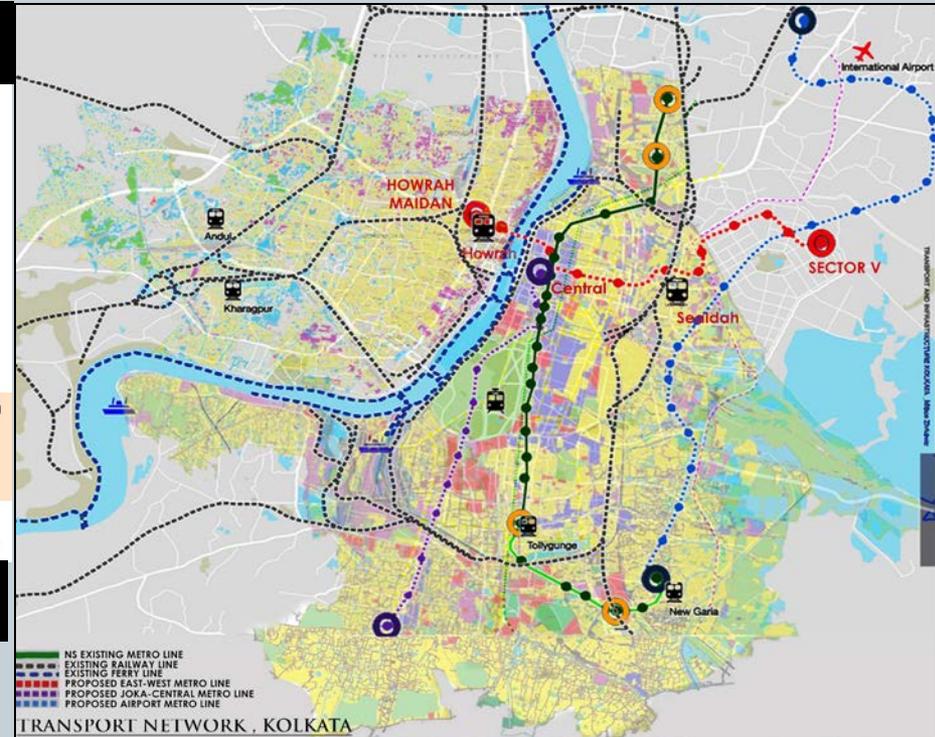
TRAVEL DEMAND

KMC, HMC, Salt Lake and **New Town** are estimated to grow from **6.5 million** in 2011 to **11.2 million** in 2021. The number of passengers having both origin and destination along the proposed metro corridor is **51,000.**

TRANS-RIVER TRAVEL DEMAND

YEAR	Daily Volume
2011	2,03,100
2021	2,77,500
2025	3,12,400

TRANSPORT NETWORK , KOLKATA

NS EXISTING METRO LINE
EXISTING RAILWAY LINE
EXISTING FERRY LINE
PROPOSED EAST-WEST METRO LINE
PROPOSED JOKA-CENTRAL METRO LINE
PROPOSED AIRPORT METRO LINE

ATL FOR KOLKATA- ALL MODES
(EXCEPT WALK)

ATL FOR HOWRAH-ALL MODES
(EXCEPT WALK)
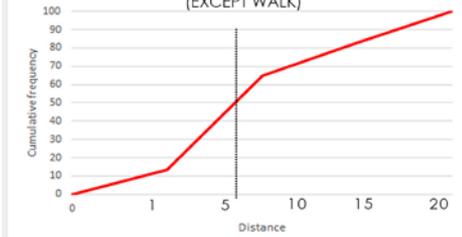
Source: Trip Data for Kolkata & Howrah: Census 2011

IMPACT OF METRO ON THE DEVELOPMENT OF TWIN CITY KOLKATA & HOWRAH

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METRO PROFILE

OPERATIONAL N-S METRO PROFILE

Operates between Noapara & New Garia
Route length: 29km (KMC)
Total Stations: 27

- The North-South Metro, the first metro introduced in India, initially operational for a stretch of **16.45** km between **Dum-Dum** and **Tollygunj**, later extended to **New Garia** in the South, and **Noapara** in the north **(12.55 km)**
- It carries 5 **lakh passengers** a day, from the northern fringes to the southern suburbs in **49 minutes**

PROPOSED E-W CORRIDOR PROFILE

To operate between Howrah Maidan & Sector V, Salt Lake
Route length: 13.77 km (8 km underground and 5.77 km elevated)
Total Stations: 12 (6 underground and 6 elevated)

- The East-West alignment goes through a very densely populated corridor with connection to **Howrah** and **Sealdah Stations** acting as feeder systems to the metro.
- At **Central metro station**, the operational N-S metro and the E-W metro line cross each other.

METRO ROUTE

STATION
N-S METRO
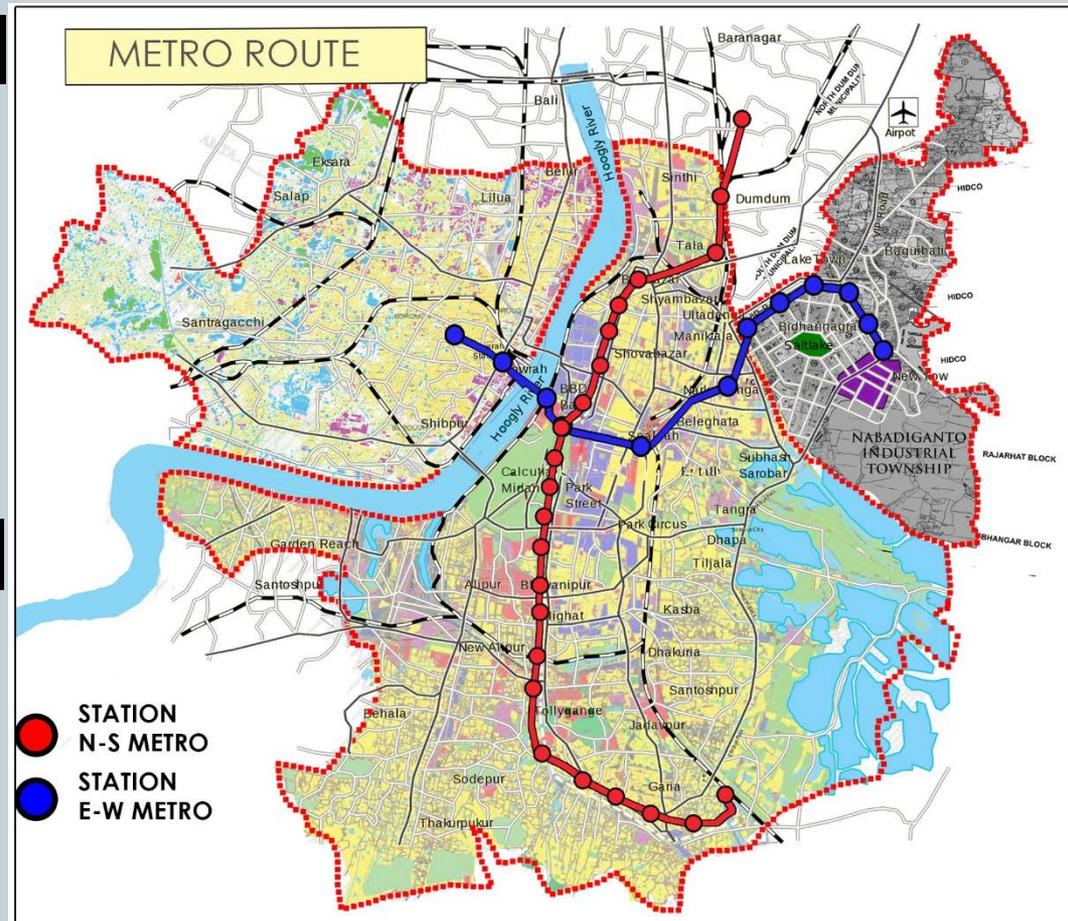
STATION
E-W METRO

- The metro also connects the cities Howrah and Kolkata to **Sector V** which is fast developing as a IT Hub and industrial township.
- The East-West metro is going to be operational tentatively from **January 2018**.

DATA BASE

DATA BASE IDENTIFICATION

| Parameters	Indicators	Data Needs	Data Source	To be used for
Spatial Transformation	• Land-use Change	Landuse maps, **Landuse survey**	**Primary Survey along Metro Corridor**	To Study the impact of Metro on a Twin city on land attributes, and create a baseline for comparative analysis.
	• FSI changes	Building Bylaws, Dev. Controls	**KMC, HMC**	
	• Population Density	Ward Population, Density	**KMC & HMC Ward Data**	
Economic Driver	• Land Value	Real Estate Survey	**Primary Survey**	To Study the impact of Metro on a Twin city as an economic driver
	• Change in economic pattern	Establishment Survey	**Primary Survey**	
Transport Network & Mobility	• **Modal Shift**	Modal Choice Options, Shift to sustainable options	**CMP Kolkata (2008)**	To Study the impact of Metro on a Network and Mobility Pattern in Twin City
		Metro Rail Passenger Data (Existing)	**Metro Rail Office, Kolkata Primary Survey for Metro User**	
		Metro Rail Passenger Data (Proposed)	**DPR for East-West Metro**	
		Suburban Rail data	**Eastern Railways**	
		Ferry Services	**CMP Kolkata (2008)**	
		Bus Services	**Calcutta State Transport Office**	

PRIMARY SURVEY LOCATIONS

PRIMARY SURVEYS

Primary Land Use Survey Along The Operational Metro Corridor:
- Undertaken along the existing Operational North South Metro Corridor, using reconnaissance survey techniques.
- Total length covered: **27.39 km**

Real Estate Agent Survey Along The Operational & Proposed Corridor
- Real Estate agent survey was undertaken both on the Operational North-South metro corridor as well as the proposed East West metro corridors to know the influence zone of the metro on land value.

Metro User and Potential User Survey Along The Operational & Proposed Corridor
- Undertaken on the Operational N-S metro corridor in order to understand the travel characteristics of the people and to estimate the travel demand on the metro in comparison with other public transport modes.
- Potential User survey was undertaken as well on the proposed E-W metro corridors (at select locations) to know the estimated travel demand on the proposed corridor.

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LANDUSE CHARACTERISTICS

SPATIAL LANDUSE CHANGE
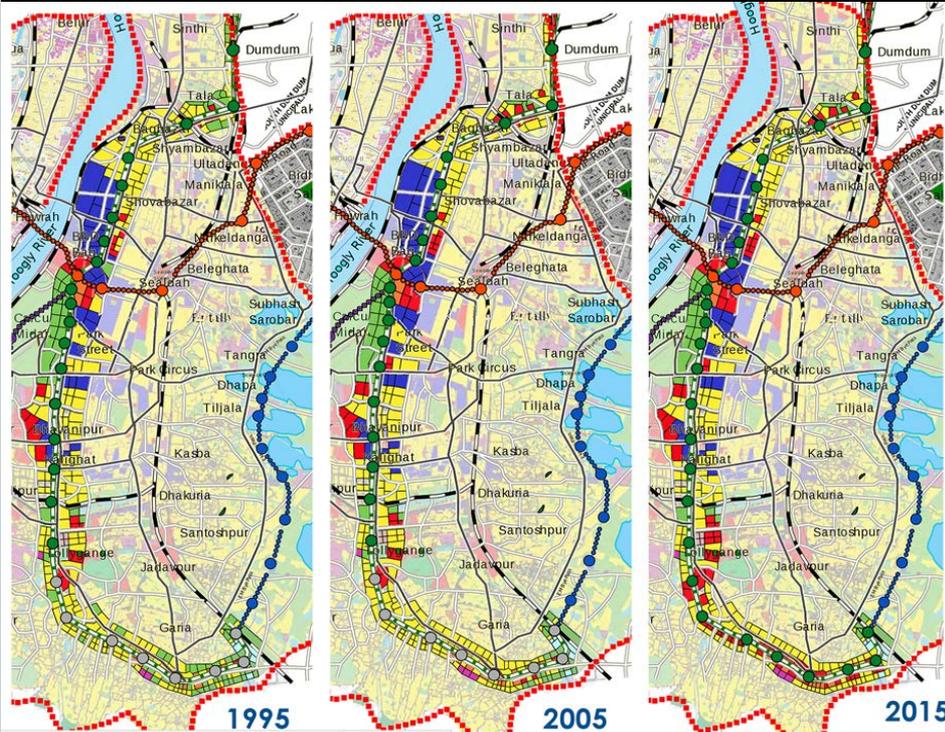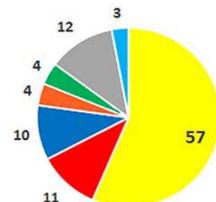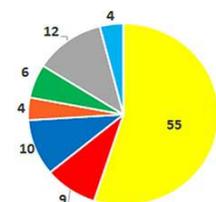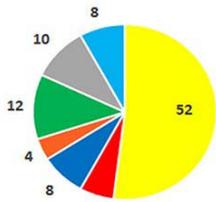
SALIENT FINDINGS

- Metro's impact has been observed in terms of conversion of residential to apartments, to mixed use and residential or mixed to commercial and new development on open/ vacant land.
- Land parcels have amalgamated to take leverage of permissible higher development opportunities in terms of FSI and building heights.
- Land use densification has emerged in terms of increased building heights. Due to increased demand of commercial & retails spaces, land scarcity for horizontal expansion and favorable development opportunities higher usage of FSI is observed in the immediate vicinity of metro station.

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LAND VALUE CHARACTERISTICS

TEMPORAL CHANGE IN LAND VALUE CHARACTERISTICS

TEMPORAL CHANGE IN LAND VALUE ALONG NS CORRIDOR (1975-2015)

Market Value

Real Value
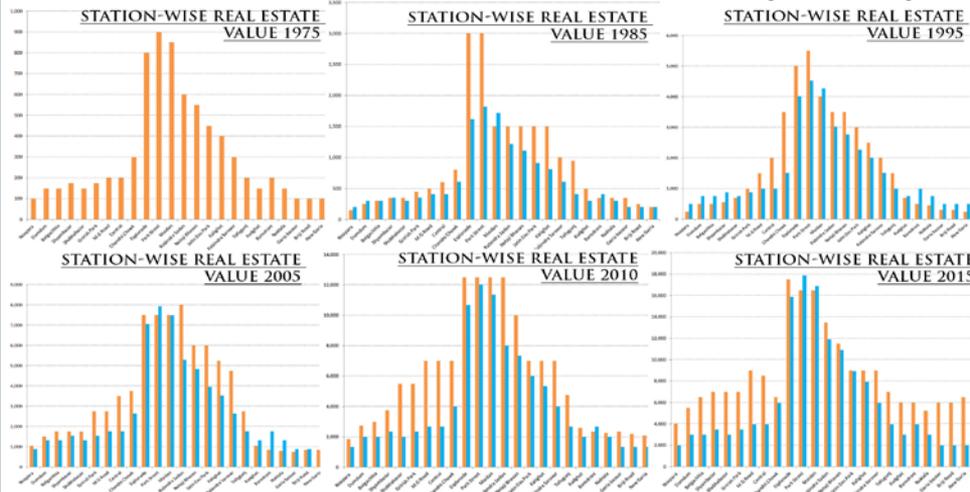
- There are **four distinct zones** of land value, based on landuse & distance from the CBD, and time of introduction of Metro
- Real estate prices escalate on the basis of certain slabs such as the **North, Central, South and later South Extension**.
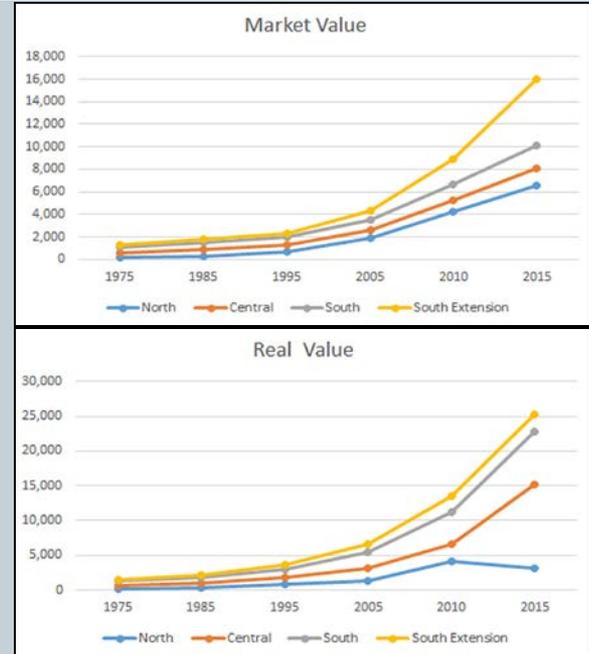
INFLUENCE OF METRO ON LAND PRICES WITHIN CATCHMENT
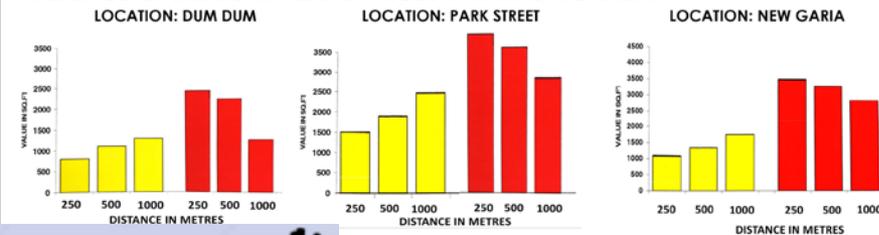
- The land value is maximum within **1 km radius** of the metro corridor.
- The commercial land value increases with proximity to the metro station.

IMPACT OF METRO ON THE DEVELOPMENT OF TWIN CITY KOLKATA & HOWRAH

METRO USER CHARACTERISTICS

METRO USER CHARACTERISTICS (N-S METRO)

Purpose Wise Trip Distribution

Frequency of Use

Type of Employment

Time Taken for Travel by Metro
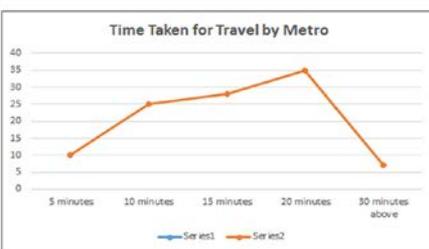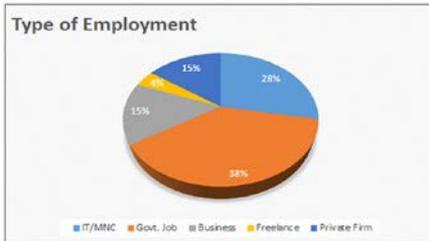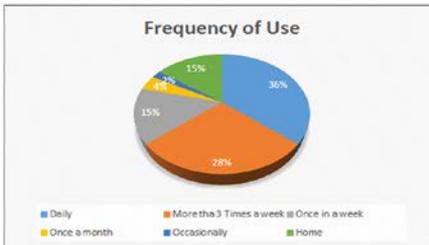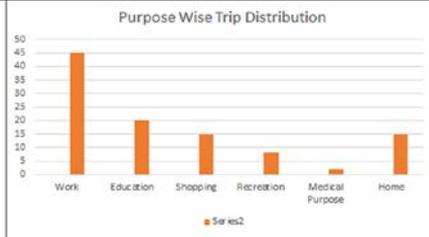
Metro Corridor Profile (NS)	KOLKATA
Length (km)	27.39
Catchment Area (sq.km)	27.39
Number of Stations	24
Average Daily Ridership (in lakh)	5.02
Density of Population (ppHA)	231.49

Access/ Egress Trip Details	KOLKATA
Access/ Egress AVG Trip Length (km)	1.5
Catchment Area (sq.km)	1.5
Average Trip Time (min)	20
Average Trip Cost (Rs)	10

Line Haul Trip Details	KOLKATA
AVG Trip Length (km)	8.6
Average Trip Time (min)	20
Average Trip Cost (Rs)	8
Purpose	Work
Frequency	Daily

Before Metro Trip Details	KOLKATA
AVG Trip Length (km)	10
Average Trip Time (min)	35
Average Trip Cost (Rs)	10
Mode	Bus
Purpose	Work
Frequency	Daily

POTENTIAL USER CHARACTERISTICS (E-W)

Preferred Mode

Purpose Wise Trip Distribution

Type of Employment

Reasons for Shifting to Metro

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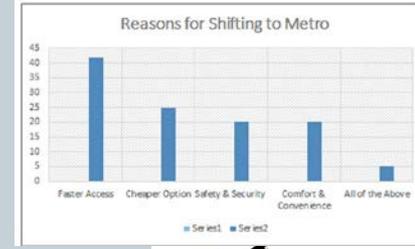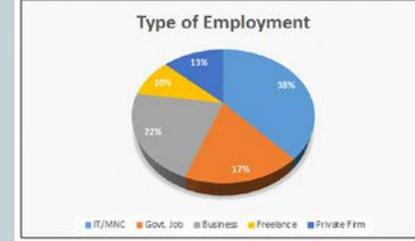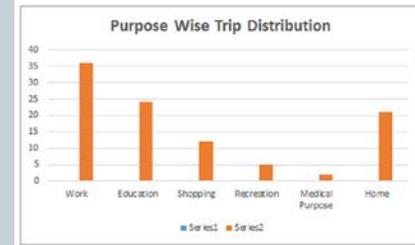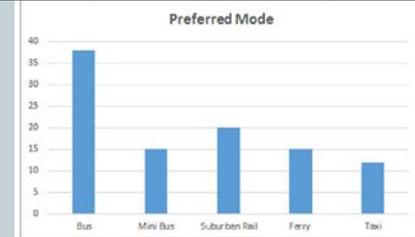
URBAN STRUCTURE MEASURES

URBAN RADIUS

It is based on the assumption that city is symmetrical around its center. The process consist of accumulating people or households, by their distance from the center of the urban area, which is divided into concentric rings of equal widths spaced at regular intervals from the Centre.
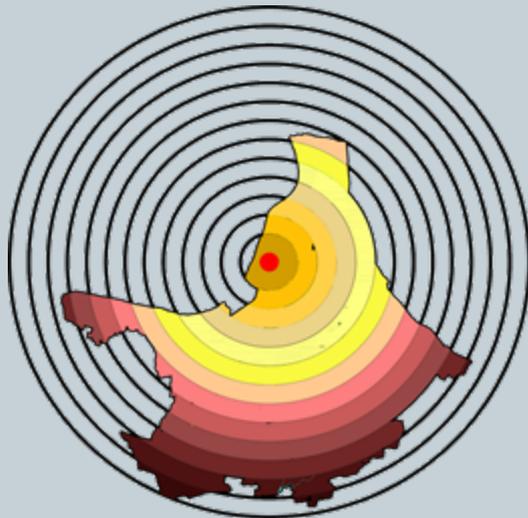
COEFFICIENT OF DISPERSION

As the population in an urban area shift over time, their spatial distribution can become either more concentrated towards city center or more dispersed away from it. A measure of such change is the coefficient of concentration or dispersion, which is defined in the following manner:

$$C.O.D = \Sigma\,|Xi-Yi|2\,;\qquad 0< A <100$$

A low value expresses an even distribution of population over the area while a high value expresses an unequal distribution.

LOCALITY ASSOCIATION FACTOR

It expresses the degree of similarity or difference between different distributions such as population and jobs. The LA factor is expressed as:

$$LA\;Factor = [100- \Sigma(Xi-Yi)]/2$$

Where, Xi = % of first group in zone i , Yi = % of second group in zone I

The value of LA factor range from 0.0 to 100.0. A high value indicates a high degree of association between the two groups and vice versa.

URBAN RADIUS OF KOLKATA

URBAN RADIUS OF HOWRAH
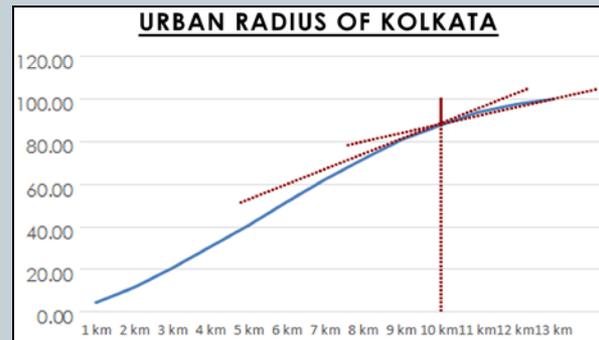
URBAN RADIUS OF KOLKATA

LA factor = 89.25
COD of Population= 6.71
COD of Employment= 15.91
Urban Radius= 10 km
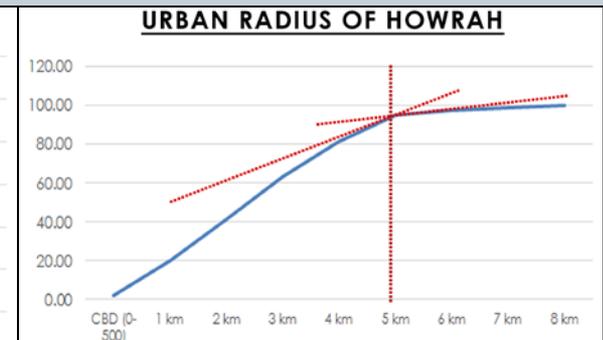
URBAN RADIUS OF HOWRAH

LA factor = 87.75
COD of Population= 13.46
COD of Employment= 16
Urban Radius= 5 km

APPLICATION OF URBAN STRUCTURE MEASURE ON INDIAN CITIES

20 CITIES MODEL

| City Categories		Cities	Population	Urban Radius (in km)	ATL (in km)
8.5 Million-20 Million	1	Mumbai	18,414,288	16.5	11.6
	2	New Delhi	16,314,838	20.1	10
	3	Kolkata	14,135,959	10	10
	4	Chennai	8,696,010.	10.8	8.6
4 Million-8.5 Million	5	Bangalore	8,499,399.	17.2	9.6
	6	Hyderabad	7,749,334	15	7.9
	7	Ahmedabad	6,240,201	13.2	6.2
	8	Pune	5,049,968	12.8	6.1
	9	Surat	4,585,367	12.5	6
1.5 Million-4 Million	10	Jaipur	3,073,350	8	6
	11	Bhopal	2,497,777	7.6	5.5
	12	Indore	2,117,990	7.6	5
	13	Patna	2,046,652.	5.4	7.8
	15	Agra	1,746,467	6.8	4.5
1 Million-1.5 Million	16	Madurai	1,462,420	3.6	5
	17	Varanasi	1,435,113	4.3	3.2
	18	Rajkot	1,390,933	7.9	6
	19	Amritsar	1,193,705	3.4	2.5
	20	Chandigarh	1,025,682.	7.4	6.5

- Metro cities have highest LA factor : high degree of association between population and jobs.
- Mega cities have highest COD of employment so mega cities have **highest degree of dispersion of employment**.
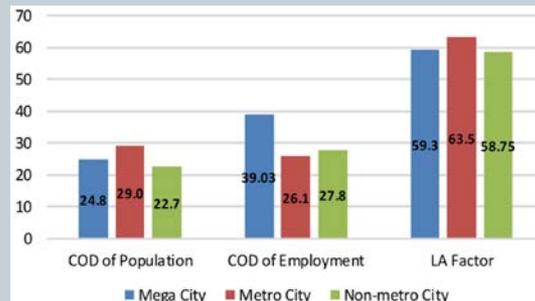
RELATION BETWEEN URBAN RADIUS & ATL
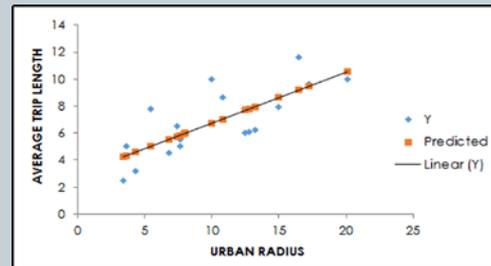
CHECKING VALIDITY OF RELATION

The Average Trip Lengths of both Kolkata and Howrah are known to us. Hence by substituting the value of 'y' in the equation we can determine 'x' ; urban radius for both cities.

ATL OF KOLKATA: 10 KM	ATL OF HOWRAH: 6.5 KM
$10 = 0.671 \, x + 3.62$	$6.75 = 0.671 \, x + 3.62$
$x = 9.75$ km ~ 10 KM	$x = 5.69$ km ~ 6.5 KM

HENCE EQUATION IS FOUND VALID FOR BOTH CASES.

RELATION BETWEEN LA FACTOR & ATL

- LA factor is a main indicator of the urban sprawl as it shows the association between the population and jobs.
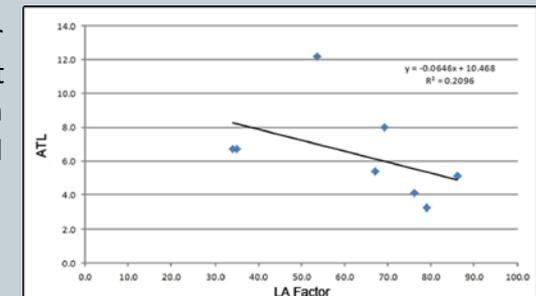
- **With increasing of the LA factor the ATL is decreasing for the city.**
- That means if the association between the population and jobs is increased, ATL will decrease.

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DEVELOPMENT OF ALTERNATE SCENARIOS

NEED

DEVELOPMENT OF ALTERNATE SCENARIOS

EVALUATION OF ALTERNATE SCENARIOS

SELECTION OF ALTERNATE SCENARIO

ALTERNATE I (DEVELOPMENT PLAN

ALTERNATE II (SPA)

URBAN STRUCTURE MEASURES
1. URBAN RADIUS
2. COEFFICIENT OF DISTRIBUTION
3. LA FACTOR

IMPACT PARAMETERS
1. MOBILITY PARAMETERS
   a) Average Trip Length
   b) Modal Share
   c) Vehicle Km
2. ENVIRONMENTAL PARAMETER
   d) Emissions

ASSUMPTIONS

SCENARIO 1

VISION 2025- DEVELOPMENT PLAN

SCENARIO 1 ASSUMPTIONS

In the Scenario 1 (as per VISION 2025), it has been assumed that development and population distribution will happen according to the Vision 2025. Population and area of planning divisions are taken from the Vision Plan.

The population projections have been adopted as per the Vision Plan 2025, for the horizon year 2021.

The employment has been taken from the East West Metro DPR (2008), for the year 2021 based on the population projections of the Vision Plan.

The population densities have not been altered, and it is assumed that the population will grow in a trend based curve, and the density will grow proportionately in the wards.

The **distribution of population and employment** determine the urban structure measures, and its subsequent impact on **mobility & environment.**

SCENARIO 2

METRO AS CATALYST FOR DEVELOPMENT

SCENARIO 2 ASSUMPTIONS

The North South operational Metro Corridor has been studied on the following parameters:

1. Landuse Mix   3. Density (Population, Employment)
2. Ridership   4. Real Estate Value

The study based on the above parameters helps determine the development induced due to the operational North-South Metro in the catchment zone with respect to that of the Kolkata city, for 2011 and horizon year 2021, in order to project the same relation for E-W Metro to Howrah.

The population projections are adopted as per the Vision 2025. However, the **population is restructured along the East West metro catchment** based on potential for redensification and infill. The density ranges are based on :

A) Availability of land in the study area.
B) Locational factors such as land value

The subsequent urban structure is measured, and with impact on **mobility & environment.**

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SCENARIO 1: DEVELOPMENT PLAN

DISTRIBUTION OF POPULATION IN KOLKATA & HOWRAH

POPULATION GROWTH IN KOLKATA & HOWRAH AS PER VISION 2025

	Population in 2011	WorkForce Participation	Employment in 2011	Estimated Population in 2021	Workforce in 2021	Estimated Employment in 2021	Inducement by 2021
Kolkata	45.86	36.77%	16.86	50	18.39	19.75	7%
Howrah	13.62	33.39%	4.55	14.2	4.74	5.41	12%

Distance Of Circle from CBD	KOLKATA				HOWRAH			
	Total population. within circle 2011	Cu. Population %	Total population. within circle 2021	Cu. Population %	Total pop. Within circle 2011	Cu. Population %	Total pop. Within circle 2021	Cu. Population %
CBD (0-500)	10,957	0.23	10,957	0.22	27,696	2.30	30,000	2.45
1 km	190,232	4.26	190,232	4.02	215,902	20.27	245,902	21.00
2 km	348,949	11.64	340,949	10.84	255,503	41.53	275,503	39.00
3 km	428,898	20.72	423,898	19.32	263,137	63.43	283,137	60.00
4 km	468,816	30.65	468,816	28.70	216,029	81.40	226,029	74.66
5 km	488,890	41.00	508,890	38.87	159,882	94.70	179,882	84.00
6 km	512,456	51.84	542,486	49.72	29,150	97.13	31,150	92.00
7 km	482,924	62.06	562,012	60.96	19,810	98.78	21,810	95.00
8 km	456,784	71.73	486,784	70.70	14,682	100.00	16,682	100.00
9 km	424,565	80.72	484,585	80.39				
10 km	320,415	87.50	360,417	87.60				
11 km	303,420	93.93	324,460	94.09				
12 km	183,495	97.81	193,020	97.95				
13 km	103,495	100.00	102,495	100.00				
TOTAL	4,580,544		5,000,000		1,362,800		1,420,600	
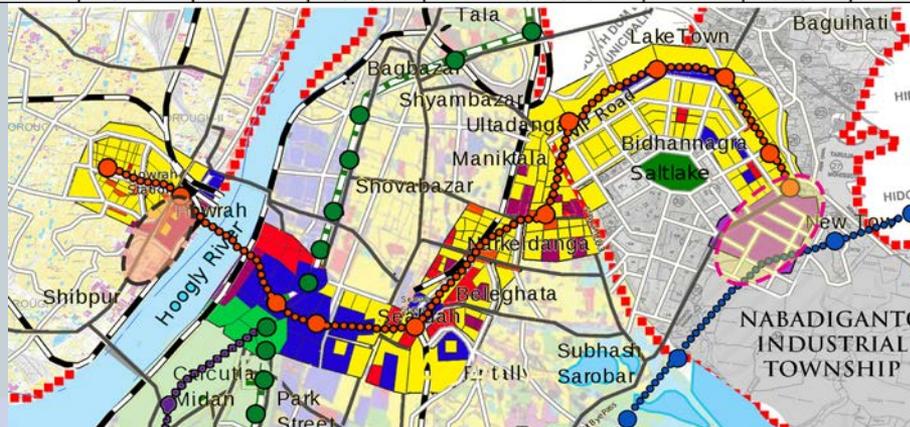
IMPACT OF METRO ON THE DEVELOPMENT OF TWIN CITY KOLKATA & HOWRAH

SCENARIO 1: DEVELOPMENT PLAN

DEVELOPMENT STRATEGIES

Modernization of CBD and Central Areas:
Administrative functions will be redistributed within the two cities.
New Secretariate building **Nabanna established in Howrah.**

Establishing New Business Centers:
New business centers will be established to reduce the congestion in the existing CBDs. **Howrah to become Metro-Sub Centre**

Employment Generation:
The scheme of **industrial township of 1500 acres in Howrah** to be completed in three phases of 500 acres each.
Expected direct employment: **14700**
Expected indirect employment : **44,000**
Sector V IT Hub to have an employment of **1.2 lakhs by 2021.**

URBAN STRUCTURE MEASURE

URBAN RADIUS OF KOLKATA 2021: Development Plan Scenario
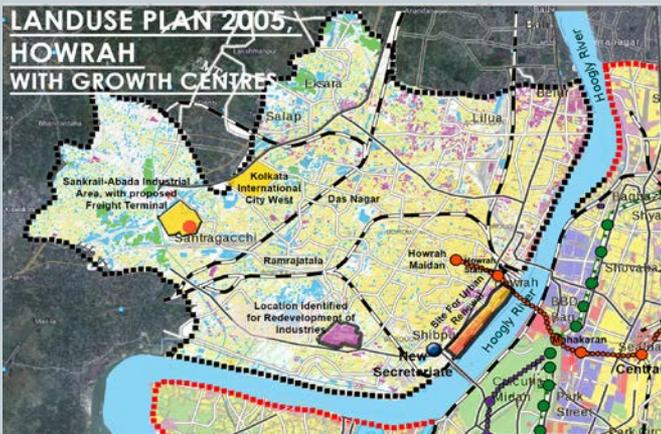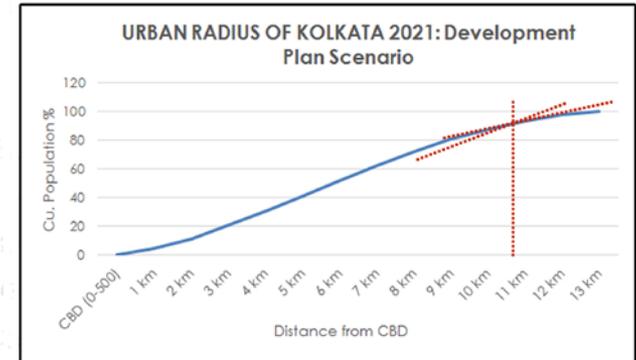
Urban Radius= 10.5 km   COD of Population   = 6.38
LA factor = 90.69   COD of Employment= 13.94

URBAN RADIUS OF HOWRAH 2021: Development Plan Scenario
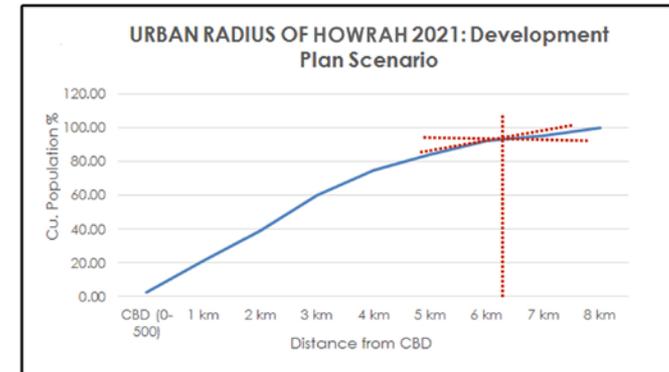
Urban Radius= 6.5 km COD of Population   = 5.48
LA factor = 87.54   COD of Employment= 17.9

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SCENARIO 1: DEVELOPMENT PLAN

IMPACT OF METRO ON DEVELOPMENT ON URBAN STRUCTURE INDICATORS

	Area (Sq. K.M.)	Population 2021 (in lakh)	Population Density 2011 (ppHa)	Population Density 2021 (ppHa)	Employee Density 2011 (Employee/Ha)	Employee Density 2021 (Employee/Ha)
Kolkata Munical Corporation	187.5	50	231	250	200	235
Howrah Municipal Corporation	64.55	14.2	195	210	165	175

IMPACT OF METRO ON DEVELOPMENT, MOBILITY & ENVIRONMENT INDICATORS

|	Average Trip Length (km) 2011	Average Trip Length (km) 2021	Modal Split 2011	Modal Split 2021	Vehicle Km 2011 (lakh)	Vehicle Km 2021 (lakh)	Emissions 2011 (tonnes/day)	Emissions 2021 (tonnes/day)
Kolkata Munical Corporation	10	10.5	Bus: 44%, Metro: 12.4%	Bus: 42%, Metro: 16.4%	45.9	45.63	323	305
Howrah Municipal Corporation	6.75	7	Bus: 49%, Metro: -	Bus: 45%, Metro: 11.4%	24.56	26.84	215	195

SCENARIO 2: METRO AS A CATALYST FOR DEVELOPMENT

N-S METRO TO CITY RELATION

	North South Catchment	Kolkata	Ratio
CITY PROFILE			
Population 2011 (in lakh)	2.75	46	0.06
Population Density 2011 (in ppHa)	350	231.49	1.5
Employee Density 2011 (in Employee/Ha)	300	210	1.42
TRAVEL CHARACTERISTICS			
Average Trip Length (km)	10.5	10	1.05
Average Trip Time (in Minutes)	20	25	0.8
Per Capita Trip Rate	1.4	1.58	0.8
Passenger Km	45.83	138.87	0.33
Cost per km	5	4.5	1.1

E-W METRO TO CITY RELATION

	HOWRAH CITY 2011	HOWRAH CITY 2021	EAST WEST CORRIDOR
CITY PROFILE			
Population (in lakh)	13.62	14.2	0.71
Population Density (in ppHa)	195	210	292.5
Employee Density (in Employee/Ha)	165	185	234.3
TRAVEL CHARACTERISTICS			
Average Trip Length (km)	6.5	7	7.0875
Average Trip Time	25	30	20
Passenger Km	101.2	109.84	36.25
Cost Per Km	6	7	8

URBAN STRUCTURE MEASURE

URBAN RADIUS OF KOLKATA 2021: SPA Scenario

Urban Radius= 9.5 km   COD of Population = 12.29
LA factor = 92.34   COD of Employment= 7.66

URBAN RADIUS OF HOWRAH 2021: SPA Scenario

Urban Radius= 5 km   COD of Population = 11.34
LA factor = 91.34   COD of Employment= 7.89

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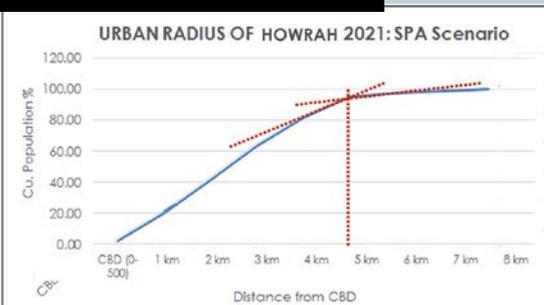
SCENARIO 2: METRO AS A CATALYST FOR DEVELOPMENT

IMPACT OF METRO ON DEVELOPMENT ON URBAN STRUCTURE INDICATORS

	Area (Sq. K.M.)	Population 2021 (in lakh)	Population Density 2011 (ppHa)	Population Density 2021 (ppHa)	Employee Density 2011 (Employee/Ha)	Employee Density 2021 (Employee/Ha)
Kolkata Munical Corporation	187.5	50	231	260	200	245
Howrah Municipal Corporation	64.55	14.2	195	230	165	180

IMPACT OF METRO ON DEVELOPMENT, MOBILITY & ENVIRONMENT INDICATORS

	Average Trip Length (km) 2011	Average Trip Length (km) 2021	Modal Split 2011	Modal Split 2021	Vehicle Km 2011 (lakh)	Vehicle Km 2021 (lakh)	Emissions 2011 (tonnes/day)	Emissions 2021 (tonnes/day)
Kolkata Munical Corporation	10	9.5	Bus: 44%, Metro: 12.4%	Bus: 40% Metro: 18%	45.9	44.80	323	296
Howrah Municipal Corporation	6.75	5	Bus: 49%, Metro: -	Bus: 42% Metro: 20%	24.56	23.45	215	150

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RESTRUCTURING DEVELOPMENT PATTERN ALONG METRO CORRIDOR

HOWRAH AS A METRO SUB CENTRE

Conservation & Urban Renewal Policy (as per **VISION 2025**) areas in **Howrah**, lying underutilised as closed mills and warehouses selected for **redevelopment & adaptive reuse**.
The site is within **2 km** of the of the Howrah Station, and the proposed Metro station at Howrah, to have **Transit Centric Development zone** around it, and propose a redensified development.

> Total Available Area : 110 Ha
> Total Developable Area : 70 Ha
> Total Built Up Area : 1 lakh sq.m
> Employee Density : 100/Ha

SECTOR V AS GROWTH CENTRE

As per the as per **VISION 2025 Sector V, Salt Lake** has been identified as an industrial growth centre & IT Hub, to cater to a population of **5 lakhs** and provide employment to more than **1.2 lakh.** The site is within **1 km** of the of the Sector V Station, **Transit Oriented Development zone** around it, having densified development using metro as a catalyst.

> Total Available Area : 82 Ha
> Total Developable Area : 66 Ha
> Total Built Up Area : 1.2 lakh sq.m
> Employee Density : 120/Ha

TOD ZONE AROUND THE HOWRAH STATION METRO

Type of Zone	Intense Zone	Standard Zone	Transition Zone
Specific Characteristics	500 m	1000 m	2000 m
	FAR 4.5	FAR 3.5	FAR 2
	500 Du/Ha	320 Du/Ha	200 Du/Ha
	Mixed Use	Commercial	Residential
Landuse Mix	Residential 40%	Residential 15%	Residential 40%
	Hotel 2%	Hotel 20%	Hotel -
	Commercial 10%	Commercial 40%	Commercial 10%
	Offices 25%	Offices 10%	Offices 5%
	Retail 5%	Retail 10%	Retail 15%
	Social 5%	Social 5%	Social 10%
	Education 5%	Education -%	Education 5%
	Cultural 3%	Cultural -%	Cultural 5%

TRANSIT CENTRIC GROWTH

REDENSIFICATION

IMPACT OF METRO ON THE DEVELOPMENT OF TWIN CITY KOLKATA & HOWRAH

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# RESTRUCTURING DEVELOPMENT PATTERN ALONG METRO CORRIDOR

HOWRAH: TRANSIT CENTRIC DEVELOPMENT

- The **location of the work place** and **working residences** kept in the zone **closest to the MRT Station** for better access.

- The Howrah station acts as a regional corridor hence hotels allocated 20% area and placed along the riverfront.

- The **high-end residential located along the riverfront** & closer to the 2nd Bridge to provide faster access to Kolkata, by road.

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COMPARISON BETWEEN 2 SCENARIOS

PARAMETERS		VISION 2025- DEVELOPMENT PLAN SCENARIO 1 - YEAR 2021		METRO AS CATALYST FOR DEVELOPMENT SCENARIO 2 - YEAR 2021	
		POPULATION DENSITY (ppHa)	EMPLOYEE DENSITY (epHa)	POPULATION DENSITY (ppHa)	EMPLOYEE DENSITY (epHa)
URBAN STRUCTURE MEASURES	DENSITY	KOLKATA: 250, HOWRAH 210	KOLKATA: 235, HOWRAH 175	KOLKATA: 260, HOWRAH 230	KOLKATA: 245,HOWRAH: 180
	POPULATION & EMPLOYMENT DISTRIBUTION	**KOLKATA** Population in the Catchment = 8.9 LAKH (19%) Employment in the Catchment = 3.5 (21%)	**HOWRAH** Population in the Catchment = 1.8 LAKH (12.3%) Employment in the Catchment = 1 LAKH (20%)	**KOLKATA** Population in the Catchment = 11.2 LAKH (23%) Employment in the Catchment = 5.4 LAKH (31%)	**HOWRAH** Population in the Catchment = 2.35 LAKH (16%) Employment in the Catchment = 1.60 LAKH (33.3%)
	URBAN RADIUS & LA FACTOR	Urban Radius= 10.5 km COD of Population = 6.38 COD of Employment= 13.94 LA factor = 90.69	Urban Radius= 6.5 km COD of Population = 5.48 COD of Employment= 17.94 LA factor = 87.54	Urban Radius= 9.5 km COD of Population = 12.29 COD of Employment= 7.66 LA factor = 92.34	Urban Radius= 4.75 km COD of Population = 11.34 COD of Employment = 7.89 LA factor = 91.34
	CITY LEVEL IMPACTS	**KOLKATA**	**HOWRAH**	**KOLKATA**	**HOWRAH**
MOBILITY	AVERAGE TRIP LENGTH (in km)	10.5 KM	6.75 KM	9.5 KM	5 KM
	MODAL SHARE	BUS: 42%, METRO: 16.4%	BUS: 42%, METRO: 11.4%	BUS: 40%, METRO: 18%	BUS: 42%, METRO: 20%
	VEHICLE KM (in lakh)	45.63	26.84	44.80	23.45
ENV.	EMISSIONS (Tonnes/day)	315	195	296	150
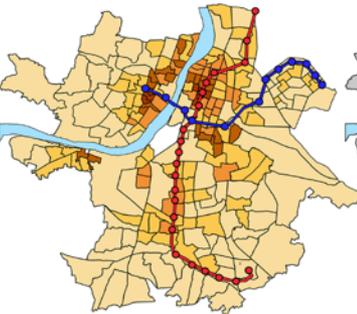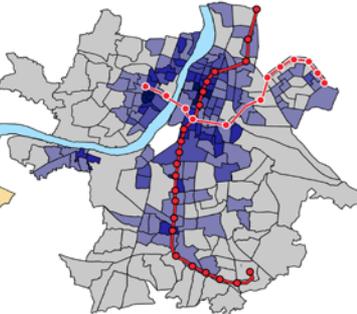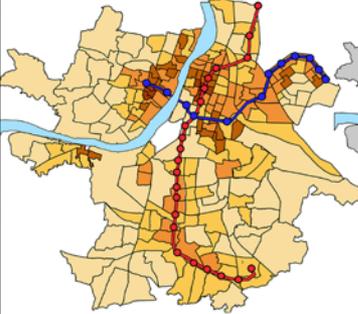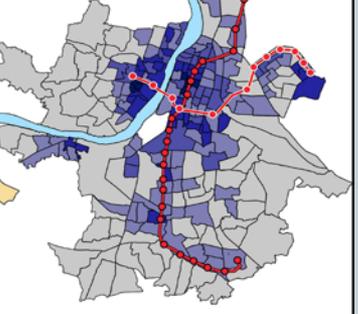
SCENARIO 2 HAS BETTER IMPACTS WHEN WHEN COMPARED WITH THE IMPACTS OF THE DEVELOPMENT PLAN SCENARIO 1

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CONCLUSIONS & RECOMMENDATIONS

SALIENT FINDINGS FROM THE STUDY:

1. Metro has the potential to induce & guide development in urban areas

2. The existing operational North South Corridor has resulted in the following impacts:
   - CHANGE TO COMMERCIAL/MIXED LANDUSE
   - INCREASE IN LAND VALUE WITHIN 1.5 KM RADIUS OF CATCHMENT
   - INCREASE IN POPULATION DENSITY WITHIN CATCHMENT

3. Urban Structure Measures are an useful tool for analysis of spatial distribution of population & jobs and its impact on mobility and environment

4. Urban Structure analysis of Kolkata and Howrah reveals that:

| MEASURES	EXISTING URBAN STRUCTURE MEASURES 2011		SCENARIO 1 (2021)		SCENARIO 2 (2021)	
	KOLKATA	HOWRAH	KOLKATA	HOWRAH	KOLKATA	HOWRAH
URBAN RADIUS (IN KM)	10	5	10.5	6.5	9.5	5
LA FACTOR	89.9	87.5	90.69	87.54	92.34	91.34
COD POPULATION	6.71	13.46	6.38	6.48	12.29	11.34
COD EMPLOYMENT	15.91	16	13.94	17.94	7.66	7.89

5. Mobility Pattern can be rapidly analysed, through Urban Structure Analysis.

6. Alternate Development Scenarios have shown the following impacts.

IMPACT PARAMETERS	EXISTING 2011		SCENARIO 1 (2021)		SCENARIO 2 (2021)	
	KOLKATA	HOWRAH	KOLKATA	HOWRAH	KOLKATA	HOWRAH
MOBILITY IMPACTS						
AVERAGE TRIP LENGTH	10	6.75	10.5	7	9.5	5
MODAL SHARE	Bus: 44% Metro:12.4%	Bus: 49% Metro: --	Bus: 42% Metro:16.4%	Bus: 45% Metro:11.4%	Bus: 40% Metro:18%	Bus: 42% Metro:20%
VEHICLE KM	45.9	24.56	45.63	26.84	44.8	23.56
ENVIRONMENTAL IMPACTS						
EMMISSIONS	323	215	305	195	296	150

URBAN RADIUS OF KOLKATA & HOWRAH COMBINED
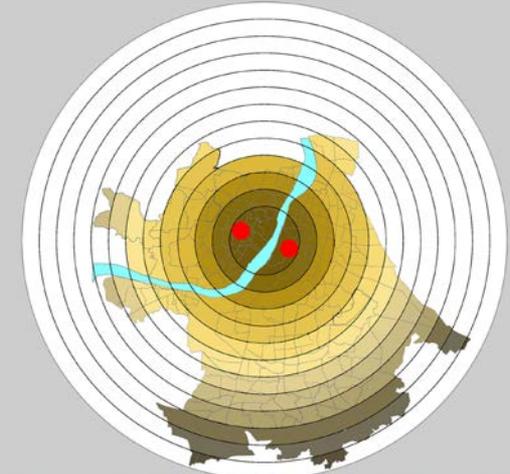
Urban Radius= 13 KM   COD of Population = 12.15
LA factor = 90.15   COD of Employment= 8.24

RECOMMENDATIONS

1. There is a need to revisit the VISION 2025 development proposals for:
   a) Population & Employment sidtribution along the prosposed East-West Corridor
   b) Consequently develop Kolkata & Howrah in a compact manner to check sprawl

2. There is a need to develop activity nodes and growth centres along the proposed at Howrah and Sector V with a potential of generating employment of around 1.5 lakhs for the horizon year 2021.

3. Restructuring of density pattern along the East-West Corridor is done as followed:

4. There is a need to plan for last mile connectivity around the transit stations for for seamless mobility interchange

WAY FORWARD

1. To assess the carrying capacity of proposed development with respect to traffic & infrastructure along the East-West Corridor for estimating the financial viability of development project.

2. To evolve Development Control Regulation & a planning standard for likely transit Centric development along the metro corridor.

3. Restructuring population along the transit corridor reduces the Urban radius, which follows the concept of a density decay curve for development which is most preferred for a compact form.